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**SUBJECT:** **ARCHITECTURAL TECHNICAL GUIDE 0020 (January 1, 2005)**  
**Mold Investigation, Mitigation, and Certification: Requirements for Single Family Housing and Multi-Family Housing Existing Construction**

**PURPOSE:**

The purpose of this Architectural Technical Guide (ATG) is to disseminate information regarding current requirements for the investigation, abatement, and post abatement certification of mold found in construction components in existing single family residences and multi-family housing projects. Mold problems in Rural Development financed properties are presently viewed by the real estate industry as a likely time bomb for future litigation. This ATG is intended to provide educational information on the subject as well as suggested policy. It contains the following major headings:

- Recommended Implementation Responsibilities,
- General Information about Mold Problems in Residential Buildings,
- Colorado Builder Forum* Article,
- Mold Inspection and Remediation Services
- Available Colorado Service Providers
- Cost Data for Mold Investigation and Abatement Services
- Additional Resources

**Recommended Implementation Responsibilities**

Mold has been around forever but now is considered a national emergency by trial lawyers, the media, and an increasing portion of the general population of the United States. A special task force has been assembled to develop a nationwide policy for the Rural Housing Service. A key player in the development of this policy will be the Rural Housing Service's Program Support Staff. Though no official policy has been developed to date, some prudent, common sense guidelines are recommended for those who will encounter this growingly recognized problem.

Whenever mold is discovered during building construction or rehabilitation efforts or is discovered in REO properties the following categories of professional services should be contracted for the property. Phased contracting of the categories is recommended for those instances where full remediation may not be intended in the decision tree due to the relationship of the appraised value of the property versus the cost of full abatement and restoration, or for other pertinent reasons (i.e. the otherwise unsuitability of the property for program reasons). All required services should be

contracted with firms with established full credentials as discussed in more detail elsewhere in this ATG. The major categories of services include:

1. A comprehensive mold inspection service
2. A cost estimate service for full mold abatement and post abatement certification services
3. A cost estimate service for full restoration services (reconstruction of the property following mold abatement)
4. A full mold abatement service
5. A post abatement certification service
6. A full restoration service

Obtaining the post abatement certification is particularly critical as this document would provide the agency with a legal recourse to future mold related litigation regarding the property in question. It would be prudent to require that the post abatement clearance certification be accomplished by an independent firm to avoid a potential conflict of interest.

Notification of the status of mold investigation, remediation, and post abatement certification work accomplished should be provided to prospective property owners as a due diligence responsibility.

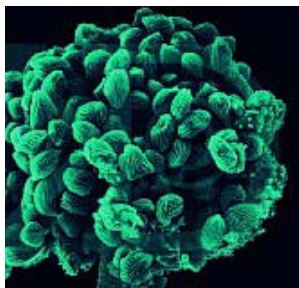
### **General Information about Mold Problems in Residential Buildings**

#### **What is mold?**

Mold is a large family of fungi (over one million species), some of which have been demonstrated to be related to respiratory (i.e. asthmatic), hypersensitivity (allergic), dermatological, and pulmonary problems of people. There are literally thousands of types of mold. The seeds of reproductive particles of fungi are known as spores, and it is usually these spores that actually cause mold allergies. A single mold growth can spawn literally millions of spores.

Many mold strains can cause these problems. A couple of special note are:

<i>Alternaria:</i>	Most common mold which can cause respiratory irritation
<i>Epicoccum:</i>	Can cause skin irritation
<i>Stachybotrys:</i>	A “black mold”. Possibly the most dangerous. Can cause pulmonary hemorrhaging.



Mold spore magnified

Along with pollens from trees, grasses, and weeds, molds are a leading cause of seasonal allergic rhinitis (inflammation of the nose). In warm regions, molds may be present year round. In colder areas, the mold season generally runs from early spring well into the fall, typically peaking during

July and August. While most molds, like pollens, are killed by the first major frost, others may persist during the winter months even in cold regions.

### **What health problems can be caused by molds?**

There are four basic categories of health problems caused by molds:

- Allergic reactions
- Hypersensitivity
- Infection
- Mycotoxicosis

Following is a discussion of each category:

#### *Allergic reactions*

Mold allergies are caused by inhaled mold spores or inhaled fragments of mold growths. While there are thousands of types of molds, only a few dozen are believed to cause significant allergies. Mold spores may lodge in the pathways of the upper respiratory system or in the lungs themselves, where they cause irritations.

Symptoms of mold allergy are similar to other allergies, including nasal congestion, sneezing, watery and itching eyes, dry tickling throat, recurrent ear infections, rashes, coughing, sore throat, post-nasal drip, and breathing difficulties. Most fungi produce proteins that are highly allergic to sensitized people.

#### *Hypersensitivity*

An individual's tolerance to molds is unique. Acute allergic reactions can progress to a chronic form. In some individuals, exposure to certain molds can lead to asthma or to a rare lung disease called allergic *bronchopulmonary aspergillosis* which is characterized by wheezing, low-grade fever, and coughing-up brown-flecked masses or mucus plugs. Individuals who have mold allergies may be more susceptible to other types of allergies.

#### *Infection*

People with compromised immune systems can develop infections, such as *blastomycosis* and *histoplasmosis*. A worst case scenario is *Coccidioidomycosis*, a chronic and fatal pulmonary infection.

#### *Mycotoxicosis*

Some fungi under certain environmental conditions can produce mycotoxins, many of which can cause very severe health effects. It is believed that *Stachybotrys*, for example, is of special concern for newborns who can develop pulmonary hemorrhagic syndrome (per the Center for Disease Control).

### **What mold levels are considered dangerous?**

Since each person's ability to resist mold problems is individual, it is difficult to design any broad health or construction standard in a "one size fits all" methodology. Neither the Environmental Protection Agency (EPA) nor the Center for Disease Control (CDC) have presently established a

Permissible Exposure Level (PEL) for mold as they have with other health hazards. Hence, it is not currently possible to absolutely know what constitutes “a lot of mold”.

### **Can one test for mold?**

There are industry-established standards for testing for mold, which include a thorough visual inspection supplemented by sample testing. Qualified laboratories can perform all the detailed analyses.

A general rule is, if you can see or smell mold, you have a mold problem.

Sample testing is presently being used to rule out mold or for comparative purposes as a part of litigation. It is not being used to enforce a standard as there is none.

### **What causes mold?**

Mold requires two primary ingredients to grow:

- A food source
- Water/moisture

The food source can be building materials such as wood and insulation products. The water/moisture can be from an undiscovered or unaddressed source such as:

- Flooding
- Leaky roofs
- Humidifiers
- Ice dams at the lower edge of the roofing
- Plumbing leaks
- Wet basements
- Improperly ventilated clothes dryers
- Plants
- Poor site drainage
- Cooking habits
- Appliances
- Poor attic ventilation rate
- Poor crawlspace ventilation rate
- Poor indoor air exchange rate (homes are “tighter” since the energy crisis)

Sustained indoor relative humidity levels of 60 percent and above can exacerbate condensation at the building envelope on cold days and support the growth of molds.

### **How does one identify water/moisture problems?**

Sources of direct water infiltration are much easier to address than moisture problems caused by high relative humidity.

Examples of obvious direct water infiltration problems:

- Flooding
- Elevated water table in basements and crawlspaces
- Plumbing leaks
- Wet basements
- Leaky roofs
- Poor site drainage
- Ice dams at the lower edge of the roofing

Examples of less obvious high relative humidity problems:

- Humidifiers
- Improperly ventilated clothes dryers
- Plants
- Cooking habits
- Appliances
- Poor attic ventilation rate
- Poor crawlspace ventilation rate
- Poor indoor air exchange rate (homes are “tighter” since the energy crisis)

Clues for identifying less obvious high relative humidity problems:

- Condensation on windows
- Dark patches along the junction of ceilings and walls (a traditional cold spot)
- Damp spots on carpeting



Mold on a ceiling around a smoke detector

### **What are some common construction scenarios that can lead to high humidity levels?**

Following are some typical examples of well intentioned, negligent, and accidental construction scenarios which can lead to elevated humidity levels inside buildings and building materials:

Building too “tightly”: The energy crisis of 1973 set in motion a tendency to seal buildings too tightly in many cases in an attempt to reduce the air infiltration loss (typically represents about one-third of the overall heat loss during the heating season). In the most northern climates, air-to-air heat exchangers have been developed to improve indoor ventilation while simultaneously reducing heat loss.

Poor site drainage: Negative drainage away from buildings, especially during major storm precipitation events can lead to wet basements, etc.

Elevated water table: Can be a problem if a basement or crawlspace is installed without the benefit of a foundation drainage system capable of artificially lowering the water table at the building.

Cathodic corrosion: Sometimes metallic water and sanitary sewer lines installed below grade and within buildings can corrode from chemical galvanic action and cause pipe ruptures. Depends on the chemical compatibility of the materials and the soil as well as the presence and chemical quality of the water.

Roof ice damming: Improper lower roof edge construction design can lead to ice-melt penetration of the lower roof membrane (shingle systems) and leakage to lower ceiling structures.

Poorly installed roof flashing: Improperly flashed roof details can provide avenues for water migration from roof membranes to lower interior building spaces.

Inadequate ventilation of attic, crawlspace, and building interiors: The model building codes have long recognized that a certain minimum number of air changes are necessary to keep humidity levels low within critical volumes within buildings. In-place construction sometimes fails to meet these standards. Sometimes interior exhaust ventilation fan systems (i.e. kitchen and bathrooms) are provided but are underutilized or abandoned. Sometimes clothes dryers are disconnected by tenants intentionally to provide a supplemental interior space heating source.

Improper placement of vapor barriers: Vapor barriers should always be installed on the warm side of insulation materials but are not on occasion by installers. Condensation will form on the warm face of the barrier and could condense within the insulation materials resulting in a large “sponge” hidden in walls.

Landscaping next to foundation walls: Major plantings and site irrigation systems located adjacent to foundation walls can result in overwatering against building structures.

In all the above instances the rate of moisture accumulation exceeds the rate of evaporation removal from buildings.

### **How can humidity be controlled in buildings?**

Humidity levels within buildings can be controlled by prudent construction practices and prudent building occupant practices. A key weapon against elevated humidity levels is adequate ventilation. Following are some more specific recommendations:

Provide model building code minimum ventilation and air exchange rate levels or better.

Provide model building code dielectric compatibility for the cathodic protection of metallic water piping and sanitary sewer piping systems, to help curtail piping system leaks caused by corrosion.

Flash roof systems in accordance with model building code and manufacturers' recommendations.

Provide adequate positive storm water drainage gradients around buildings based on engineering recommendations, special site constraints, and storm event predictions.

Avoid construction at areas with elevated water tables and near floodplains. If this is unavoidable, provide an engineered permanent foundation subdrainage system.

Construct lower roof systems to take ice damming into account, especially in areas with higher snow levels.

Correctly position building vapor barrier systems.

Avoid/reduce landscaping plantings and irrigation system installations adjacent to foundation walls.

Augment existing exhaust ventilation systems.

Modify existing exhaust ventilation systems to operate automatically via humidistats, etc.

Humidity levels within buildings must also be controlled by the proactive participation of building occupants.

### **Why has mold in buildings suddenly become such an issue?**

Addressing molds, toxic materials, ventilation rates, and other issues which control indoor air quality is part of a gradual trend in the United States to improve indoor air quality as an outgrowth of the building tightness excesses of the energy crisis era. Architects, engineers, building contractors, model code organizations, consumer advocacy groups, and other interested parties are gradually coming to grips with the general population's desire to encourage environmental friendliness.....with a little extra pressure from the threat of litigation.....



The subject of mold issues within buildings has received increased media attention since the late 1990s. Related litigation increased and insurance providers began to exempt mold related mitigation measures from homeowners policies. One of the main insurance providers' concerns was the inability to identify the degree of the problems against actual standards which were nonexistent.

### **Colorado Builder Forum Article**

An interesting article, entitled, “The Battle Behind ‘Toxic Mold’”, appeared in a 2003 issue of the publication, *Colorado Builder Forum*. Interesting because it discussed a new area where this problem has been recognized as appearing in Colorado: in structural wood basement floors.

It seems to be a case of solving one structural problem causing another unexpected hygienic problem. The first intention was to derive an engineering solution to clear-span over moderately to highly expansive soils underneath homes. An unexpected end result was the creation of a hidden space where molds could grow.

Following is an excerpt from the article in the *Colorado Builder Forum* that may be of interest to Rural Development personnel involved with providing financing for such floor systems.

**“As builder’s know, Colorado has the dubious distinction of being the only state in the nation designated by the federal government as ‘high-risk’ for expansive soils. Typical slab-on-grade basement floors will heave crack and even fail when expansive soils get wet and the dry. Paying for repairs has cost builders ‘tens of millions, if not hundreds of millions of dollars’, Fronapfel (Ed Fronapfel, P.E.) said.**

**Structural basement floors, which float above the surface, were designed to address the problem. But now builders are finding that their solution is presenting yet another problem: trapped moisture can lead to mold growth.**

**Fronapfel said he has looked under 1,500 to 2,000 structural floors and found moisture problems in 75 to 90 percent of them. Moisture is a major issue for the floors because most of them are made primarily of wood, which presents a natural food source for mold. Mold and even wet-dry cycles also compromise the structural integrity of the floors, which can lead to foundation problems, said Fronapfel.**

**The mantra for controlling mold is simple and effective: control the moisture.**

**Moisture in the crawlspace under subfloors is nothing unheard-of, and builders have been designing ventilation systems to keep the spaces dry. But much of the problem has been the design itself, which has not been as effective, or as standard, as planned.**

**‘I believe design – or maybe I should say lack of design – is 90 percent of our problem,’ said Fronapfel.**

**He said builders must meet all the criteria – from moisture barriers to ventilation to proper site drainage – in order to control moisture and prevent mold growth. Failure of one element – even homeowners have been known to turn off the ventilation fan because of the noise – lead to problems down the road.**

**In response to the challenges, Fronapfel is seeing a change in building code requirements. In Arvada, plans now must have a mechanical engineer’s approval for the performance of the structural floor, including moisture control.”**

If a Rural Development employee were to receive such a proposal for a residential development, it is recommended to apply the “Arvada rule”, requiring a mechanical engineer’s approval for the performance of the structural floor, including moisture control.

Another option being employed by builders as an alternative to the structural wood floor systems has been installing structural concrete floor systems. These are typically more expensive than floating concrete slabs-on-grade and differ in that they contain much more significant reinforcing steel designed to clear-span above the floor of basement excavations.



## **Mold Inspection and Remediation Services**

A thorough physical inspection of a home to find evidence of mold problems involves a comprehensive analysis by a professional firm specializing in mold investigation and analysis. Typically such inspection services attempt to identify signs of water and mold damage and to accomplish an extensive mold testing and mold investigation utilizing available types of mold testing technology (i.e. a hidden moisture meter to find water hidden inside walls, ceilings, and floors, fiber optics inspection devices to find mold hidden inside walls, ceilings, and floors, and hygrometers to check buildings for elevated levels of mold-causing humidity).

Mold abatement follows procedures similar to those exercised for asbestos abatement since both environmental hazards primarily involve contaminants that are inhaling hazards. For this reason, many environmental remediation firms that perform asbestos abatements are also willing to address mold abatements. The full realm of mold investigation and abatement services covers the following categories:

- Air sampling for mold spores
- Wipe, swap, and tape lift sampling for mold spores
- Bulk sampling for mold spores
- Fiber optic and other device assessments for hidden evidence of mold
- Microbiology analysis
- Abatement cost estimating
- Full containment mold abatement
- Post abatement clearance sampling
- Post abatement building restoration



When contracting for the above services, all the usual rules apply regarding preparing statements of work for hazardous materials remediations:

- Clearly identify desired services.
- Write in a short, concise manner.
- Avoid telling the service provider how to accomplish the work aside from providing useful coordination information.
- Identify performance expectations (i.e. accomplish all work necessary to achieve a post abatement clearance certification).

- State that the service provider will furnish adequate credentials and a resume.
- State that the service provider will accomplish all work in strict accordance with applicable State and Federal regulations as well as industry standards.
- Design tasks in phased stages in cases where appropriate (and, if this option is exercised, state that partial payment will be accomplished at the conclusion of each phase). Following are some potential phases:
  - Provide a thorough investigation
  - Provide a cost estimate for full abatement
  - Provide full abatement
  - Provide a post abatement clearance certification
- It would be prudent to require that the post abatement clearance certification be accomplished by an independent firm to avoid a potential conflict of interest.
- Require itemized cost breakdowns for all services, for verification. Following is an example of some typical categories of abatement services likely to be encountered:
  - Building component tear-out, cleaning, and bagging for removal
  - Application of an anti-bacterial agent
  - Dehumidification
  - Furnace and ductwork cleaning
  - Appliance cleaning
  - Fixture cleaning
  - Vacuuming, sanding, and sealing
  - Negative air pressure fan operation
  - Personal protective equipment charges
  - Personal respirator charges
  - HEPA replacement filter charges
  - Equipment decontamination charges
  - Pre and post abatement sampling charges
  - Electrical system testing for operational status
  - Heating, ventilating, and air-conditioning (HVAC) system testing for operational status
  - Overhead (usually up to 10 percent)
  - Profit (usually up to 10 percent)

### **Available Colorado Service Providers**

The Yellow Pages and Internet links contain references to many service providers available to perform operations in Colorado. Since Denver is a regional city, many of the providers are centered around the Denver metropolitan area. Following is a list of some of the available providers and this list should not be considered comprehensive or exclusive:

**Colorado Mold Inspection, LLC**  
 303.901.6425 or 303.901.6407  
 (Range of services unknown)

**Colorado Quality Air Sciences**  
 1120 38th Avenue, Suite #3  
 Greeley, CO 80634  
 970.356.5422  
 (Investigation services)

**Coyle Inspection Engineers, Inc.**

2170 S. Parker Rd., #240  
Denver Colorado 80231  
303.745.5209  
(Full services)

**Discovery Inspection Service, LLC**

Post Office Box 6067  
Broomfield, CO 80021-6067  
303.464.8006  
(Range of services unknown)

**DM Inspections**

Denver, CO  
720.338.9989  
(Range of services unknown)

**Environmental Sciences of Colorado, Inc.**

Corporate Headquarters  
1812 56th Avenue Suite C  
Greeley, Colorado 80634  
970.506.1312  
800.978.7972  
(Full services)

**Gateway Home Inspection Inc.**

P.O. BOX 746632  
Arvada CO. 80006-6632  
720.334.7017  
(Investigation services)

**Hardy Environmental Services**

2121 N. Frontage Rd. W., #24  
Vail, CO 81657  
970.479.9774  
(Full services)

**HERRON Enterprises USA, Inc.**

Lakewood, CO  
303.763.9639  
(Range of services unknown)

**Mold Identification Technology Incorporated**

Centennial, CO  
720.876.2364  
(Range of services unknown)

**Mold Mitigation**

Grand Junction, CO  
970.245.5897  
(Range of services unknown)

**Occupational Health Technologies, Inc**  
Colorado Springs, CO  
719.227.8511  
(Range of services unknown)

**Paul Davis Restoration**  
948 South Sante Fe Avenue  
Pueblo, CO 81006  
719.583.8080  
(Abatement and post abatement services)

Additional firms may be located at the following Internet sites:

<http://www.certifiedmoldinspectors.com/>  
<http://www.enviroyellowpages.com/listings/USA/CO/3ed8ffa5bc515120b68618ff291cf078>  
<http://phonebook.superpages.com/yellowpages/C-Home+&+Building+Inspection/S-CO/T-Denver/>  
[http://www.digitaldiagnosticsystems.com/directory\\_of\\_inspectors.htm](http://www.digitaldiagnosticsystems.com/directory_of_inspectors.htm)  
[http://www.startremodeling.com/toxic\\_mold\\_inspectors.htm](http://www.startremodeling.com/toxic_mold_inspectors.htm)  
<http://www.moldinspector.com/certified-mold-inspector.htm>  
<http://www.moldpro.org/directory/display/?state=CO>

### **Cost Data for Mold Investigation and Abatement Services**

Maintaining cost data for mold investigation and remediation components is critical for statewide dissemination. A copy of cost information associated with all contracts for mold hazard investigation and remediation should be forwarded to the State Environmental Coordinator. Detailed information is particularly crucial. Please forward by fax, email, or regular mail in this regard: (1) the scope-of-work of the service(s) and (2) the cost information (i.e. bids). There are no special formatting requirements for any of this information at this time. A simple photocopy of the information would be fine with any annotations you feel would be pertinent.

### **Additional Resources**

More information on this subject may be obtained at the following Internet sites:

EPA "Indoor air – Mold/Moisture" website @  
<http://www.epa.gov/aq/pubs/moldresources.htm>

American Academy of Allergy, Asthma & Immunology website @  
<http://www.aaaai.org>

Centers for Disease Control and Prevention website @  
<http://www.cdc.gov>

Should you have any questions, please feel free to contact the State Architect.

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